

Columbia River Project Water Use Plan

Columbia River White Sturgeon Management Plan

Monitoring Program and Physical Works

Annual Report: 2014

Implementation Period: May 2013 to April 2014

- **CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use**
- **CLBMON-20 Mid Columbia River White Sturgeon Spawning Habitat Assessment**
- **CLBMON-21 Mid Columbia River Juvenile Sturgeon Detection and Habitat Program and Tracking of Existing Sonic Tagged Sturgeon**
- **CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility**
- **CLBMON-24 Mid Columbia River Sturgeon Genetics**
- **CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use**
- **CLBMON-26 Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability**
- **CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing Study**
- **CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring**
- **CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring**
- **CLBMON-30 Lower Columbia River Opportunistic Assessment of High Flow Events**
- **CLBMON-54 Mid Columbia Effects of REV 5 Flow Changes on Incubation and Early Rearing Sturgeon**
- **CLBWORKS-24 Mid Columbia Experimental Aquaculture**
- **CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture**
- **CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery**
- **CLBWORKS-27 Lower Columbia Bentonite Addition Experiment**
- **CLBWORKS-28 Lower Columbia River Planning and Assessment of WSG Turbidity**
- **CLBWORKS-34 Lower Columbia Sturgeon Conservation Aquaculture Program**

Licences for Kinbasket storage (27068 and 39432), Mica diversion (39431), Revelstoke diversion and storage (47215), and Arrow storage (27066)

May 31, 2014

BC Hydro Columbia River Project Water Use Plan Columbia River White Sturgeon Management Plan Monitoring Programs and Physical Works Annual Report: 2014

1 Introduction

This document represents a summary of the status and the results of the Columbia River White Sturgeon Management Plan Water Use Plan (WUP) monitoring programs and physical works to April 30, 2014, as per the Columbia River Order under the *Water Act*, dated January 26, 2007. There are 12 monitoring programs and six physical works.

2 Status

The following table outlines the dates that TOR for the Columbia River White Sturgeon Management Plan WUP monitoring programs and physical works were submitted to and approved by the CWR.

BC Hydro will convene a multi-party panel five years after commencing the implementation of this WUP to evaluate the effectiveness of operations and physical works in meeting the stated objectives for Arrow Lakes Reservoir and the lower Columbia River. The outcomes from this process will be used to assess any potential need to review the Arrow Lakes Reservoir component of this WUP. If a replacement Non-Treaty Storage Agreement (NTSA) is negotiated within this 5-year period, it is also recommended that agreement provisions and implications be reported out through this panel. Signing of a new NTSA is not a trigger for panel evaluation or a review of this Water Use Plan recommendation to change operations.

Table: 2-1: Dates of Columbia River White Sturgeon Management Plan WUP TOR Submissions and Approvals by the Comptroller of Water Rights

Monitoring Program & Physical Works TOR	Order Clause	Original ToR Submission		Most Recent ToR Resubmission	
		Date Submitted	Date Approved	Date Submitted	Date Approved
CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use	Schedule F.1.a	Feb 22, 2008	Apr 24, 2008		
CLBMON-20 Mid Columbia River White Sturgeon Spawning Habitat Assessment	Schedule F.1.b	Feb 22, 2008	Apr 24, 2008	Aug 21, 2009	Nov 10, 2009
CLBMON-21 Mid Columbia River Juvenile Sturgeon Detection and Habitat Program and Tracking of Existing Sonic Tagged Sturgeon	Schedule F.1.c, Schedule F.1.d	Jun 15, 2007	Jul 11, 2007		
CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility	Schedule F.1.e	Jun 15, 2007	Jul 11, 2007	Apr 16, 2009	Apr 30, 2009
CLBMON-24 Mid Columbia River Sturgeon Genetics	Schedule F.1.f	Scheduled for 2016			
CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use	Conditional List 9.b	Conditional			
CLBMON-26 Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability	Clause 10.c Conditional List	Jan 07, 2009	Mar 19, 2009		
CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing Study	Schedule F.1.g	Jan 07, 2009	Mar 19, 2009		
CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring	Schedule F.1.h	Feb 22, 2008	Apr 24, 2008		
CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring	Schedule F.1.i	May 12, 2008	Jun 25, 2008		
CLBMON-30 Lower Columbia River Opportunistic Assessment of High Flow Events	Schedule F.1.j	Jan 07, 2009	Mar 19, 2009		
CLBMON-54 Mid Columbia Effects of REV 5 Flow Changes on Incubation and Early Rearing Sturgeon	Clause 2.e of the Amended Order	Aug 21, 2009	Oct 19, 2009		
CLBWORKS-24 Mid Columbia Experimental Aquaculture	Schedule F.3.a	Apr 17, 2008	May 12, 2008		
CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture	Schedule F.3.b	Apr 17, 2008	May 12, 2008		
CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery	Schedule F.3.c	Apr 17, 2008	May 12, 2008		
CLBWORKS-27 Lower Columbia Bentonite Addition Experiment	Conditional List 10.a	Conditional			
CLBWORKS-28 Lower Columbia River Planning and Assessment of WSG Turbidity	Schedule F.2.a	Mar 31, 2010	Jun 03, 2010		
CLBWORKS-34 Lower Columbia Sturgeon Conservation Aquaculture Program	Schedule F.3.b	Apr 17, 2008	May 12, 2008		

3 Schedule

The following table (Table 3-1) outlines the current schedule for the monitoring programs and physical works being delivered for the Columbia River White Sturgeon Management Plan WUP

Table 3-1: Table of WUP Schedule

Monitoring Programs	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
	WLR YR1	WLR YR2	WLR YR3	WLR YR4	WLR YR5	WLR YR6	WLR YR7	WLR YR8	WLR YR9	WLR YR10	WLR YR11	WLR YR12	WLR YR13 Final Review
CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use		✓	✓	✓									
CLBMON-20 Mid Columbia River Spawning Habitat Assessment				×	✓	✓	✓						
CLBMON-21 Mid Columbia River Juvenile Sturgeon Detection and Habitat Program and Tracking of Existing Sonic Tagged Sturgeon	✓	✓	✓	✓	✓	✓	✓	■	■	■			
CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility	✓	✓	✓	✓	✓	✓	✓	■	■	■			
CLBMON-24 Mid Columbia River Sturgeon Genetics									■				
CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use	C*												
CLBMON-26 Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability				✓	✓	✓	✓						
CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing Study			✓	✓	✓								
CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring		✓	✓	✓	✓	✓	✓	■	■	■	■	■	■
CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring		✓	✓	✓	✓	✓	✓	■	■	■	■	■	■
CLBMON-30 Lower Columbia River Opportunistic Assessment of High Flow Events			✓	✓	✓	✓	✓	■	■	■	■	■	
CLBMON-54 Mid Columbia Effects of REV 5 Flow Changes on Incubation & Early Rearing Sturgeon				×	✓	✓	✓						
Physical Works													
CLBWORKS-24 Mid Columbia Experimental Aquaculture		✓	✓	✓	✓	✓							
CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture						✓	✓	■	■	■	■		
CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery		✓	✓										
CLBWORKS-27 Lower Columbia Bentonite Addition Experiment	C*						del	■	■	■	■	■	
CLBWORKS-28 Planning and Assessment of WSG Turbidity				✓	✓	✓							
CLBWORKS-34 Lower Columbia Sturgeon Aquaculture Program		✓	✓	✓	✓	✓	✓	■	■	■	■	■	■
Legend: <ul style="list-style-type: none"> ■ = Program to be undertaken/initiated in identified year u/w = Project is under way ✓ = Program completed for the year del = Program is delayed × C* = Program is on the conditional list 													

4 Monitoring Programs and Physical Works Terms of Reference

The Monitoring Programs and Physical Works being implemented under the Columbia River White Sturgeon Management Plan WUP are described in Terms of Reference. These Terms of Reference and the reports for work completed to date can be found here:

http://www.bchydro.com/toolbar/about/sustainability/conservation/water_use_planning/southern_interior/columbia_river/columbia-sturgeon.html

5 Summary of Monitoring Programs

5.1 CLBMON-19 Kinbasket Sturgeon Inventory and Habitat Use

5.1.1 Status

This monitoring program was initiated in 2008 and was carried out over a three-year monitoring period ending in 2011. The final report from this work helped inform CLBMON-26 described below.

5.2 CLBMON-20 Mid Columbia River White Sturgeon Spawning Habitat Assessment

5.2.1 Status

This monitoring program was initiated in 2010 and will be carried out over a three-year period ending in 2014. No report is attached. The expected final report has been delayed due to additional substrate analysis and modelling scenarios developed to incorporate several proposed flow treatments and to further address the management questions. The additional work also includes expanding the modelling through BC Hydro's Revelstoke Unit 6 environment project, which has proved beneficial to the analysis being conducted under the Columbia WUP study. The report covers a significant amount of work and should be final in August 2014 and will be submitted in next year's report.

This project is based primarily on advanced hydraulic modelling which has taken a three-year period to validate with field sampling over a range of Revelstoke Dam Discharges and Arrow Lakes Reservoir elevations. The work has been implemented with CLBMON-54, due to similarities in management questions and methodology. The overall objective of these studies is to model the effects of Revelstoke Dam discharges and ALR levels on velocity/depth patterns in the White Sturgeon egg deposition/incubation and early rearing area. Using these results and what is known about White Sturgeon spawning and early rearing habitats, inferences will be made regarding the potential effects on White Sturgeon spawning suitability. The modelling results have been extremely informative to date and the model was also expanded to help determine any incremental effects of the increased discharge from the addition of Revelstoke Unit 6 on sturgeon spawning habitat. The work is going to be an important piece of literature demonstrating the usefulness of such techniques in describing both hydraulic properties of critical fish habitat and possible mitigation options.

5.3 CLBMON-21 Mid Columbia River Juvenile Sturgeon Detection and Habitat Program and Tracking of Existing Sonic Tagged Sturgeon

5.3.1 Status

This monitoring program was initiated in 2007 and will be carried out over 10 years ending in 2016. No report is attached for this year due to a short field season without any luck capturing juveniles released from the hatchery program. The program has switched back to being focused on fish capture to described growth and, if capture rates improve, survival from the hatchery program. This was the focus of the past year and extra effort was expended to sample throughout the reservoir. A data report is in draft form and will be included as part of a larger report on this program submitted with next year's annual management plan report.

For several years, this program has relied on advancements in telemetry (acoustic positing system) to address questions regarding habitat use at different reservoir elevations that were not feasible to address using more indirect means (direct capture). However, despite the success of generally addressing that specific question, significant uncertainty remains regarding the growth and survival capacity for juvenile sturgeon released from the hatchery program. This was identified as a key requirement for this program to focus on based on the technical review completed in 2012. This program will focus for the final four years on addressing these questions.

5.4 CLBMON-23 Mid Columbia River Sturgeon Egg Mat Monitoring and Underwater Videography Feasibility

5.4.1 Status

This monitoring program was initiated in 2007 and will be carried out over 10 years ending in 2016. Attached is the report for Year 7 dated April 2014.

Project is set up with consistent monitoring based on the outcome of the Mid-Columbia White Sturgeon Management Plan midterm review which occurred in 2012. No significant change to the delivery or implementation of this program. One key focus is to bank tissue samples for genetic analysis under CLBMON-24 towards the end of the WUP. To date, very few tissue samples have been obtained as a result of low larval capture numbers.

5.5 CLBMON-24 Mid Columbia River Sturgeon Genetics

5.5.1 Status

This monitoring program is not planned to be initiated until 2016 due to the additional collection of genetic samples prior to project implementation. The program will analyze historical adult samples and samples collected from monitoring under CLBMON-23.

5.6 CLBMON-25 Kinbasket Juvenile Sturgeon Detection and Habitat Use

5.6.1 Status

This is a conditional study and will be implemented, if necessary, following the outcomes of a technical review tentatively scheduled for 2015 or early 2016. A

decision was made at the Mid-Columbia White Sturgeon Management Plan midterm review in 2012 to focus on questions related to sturgeon recovery in the Arrow Lakes Reservoir before conducting concurrent work in Kinbasket. This conditional study, if implemented, will focus on identifying any unresolved questions rising from CLBMON-26, described below.

5.7 CLBMON-26 Kinbasket Sturgeon Recolonization Risk Assessment and Habitat Suitability

5.7.1 Status

This monitoring program was initiated in 2010 and will be carried out over about a three-year period ending in 2014.

Phase 1 was an ecological risk assessment that is now complete and forms the basis of the early reports submitted. At the Mid-Columbia White Sturgeon Management Plan midterm review in 2012 a decision was made to prepare a conservation aquaculture strategy that, even though not implemented, would help inform future discussions around the use of Kinbasket reservoir as a failsafe or recovery area for White Sturgeon. A conservation aquaculture strategy is in draft form and is being finalized however not in time for submission with this report as it requires review by several technical experts. It will be included in the annual report submission next year.

5.8 CLBMON-27 Mid Columbia River Sturgeon Incubation and Rearing Study

5.8.1 Status

This monitoring program was initiated in 2009 and was carried out over three years ending in 2012.

5.9 CLBMON-28 Lower Columbia River Adult Sturgeon Population Monitoring

5.9.1 Status

This monitoring program was initiated in 2008 and will be carried out over 12 years. Reports covering Years 5 and 6 are being finalized currently and expected late summer 2014. They will be included in next year's submission and are delayed due to multiple groups being involved in contributing to the work. One major addition to the program is the initiation of a systematic stock assessment that was started in 2013 to estimate the number of White Sturgeon in the transboundary reach of the Columbia River. This study represents the first systematic population estimate for the entire transboundary reach and a secondary objective is to estimate survival of hatchery released juvenile in this reach. This work is being completed in partnership with recovery team members from the United States. The stock assessment is being implemented in two sessions annually, one in the spring and one in the fall. The project will continue for five years, ending in 2018 and will be very important for recovery of White Sturgeon in the Columbia.

Significant progress has been made addressing questions regarding reproductive ecology in the lower Columbia River using molecular methods and results from this work have resulted in new recovery goals. One of these has been implemented in an attempt to improve genetic diversity in supplemental progeny stocked into the Columbia River from CLBWORKS-34 and is described in the status update for that

study. We have also had a paper from that work accepted for publication in the scientific journal Transactions of the American Fisheries Society. Below is the abstract from that publication. Results and methods employed in this study will be important for other recovery programs for sturgeon species in North America.

*Estimates of effective number of breeding adults and reproductive success for White Sturgeon *Acipenser transmontanus**

Abstract: Accurate estimates of the number of adults contributing to offspring (N_s), effective breeding number (N_b), and estimates of individual adult contributions to recruitment are required for recovery planning for endangered White Sturgeon *Acipenser transmontanus* populations, many of which are suffering from prolonged periods of recruitment failure. We show that genetic techniques can be used to characterize important features of White Sturgeon reproductive ecology in large rivers where census data are extremely difficult to obtain. We used microsatellite loci ($n=12$) and likelihood-based pedigree analysis to estimate N_s , N_b , number of kin groups (N_k) and individual reproductive success of White Sturgeon contributing to viable eggs and larvae collected in the Upper Columbia River in each of two years. Estimates of mean annual N_s , N_b , and N_k (mean \pm SD) were 121.5 ± 34.7 , 86.5 ± 10.6 , and 73.5 ± 17.3 , respectively. Large variations in estimates of N_s , N_b , and N_k were observed between spawning areas ($n=3$), with one spawning site representing 61% of total adult spawning population. Variation in adult reproductive success was observed within and among sites. Individual spawning duration (1.9 ± 1.1 days) and number of mates per adult (2.9 ± 2.5) likewise varied spatially and temporally. Based on age of collected eggs and larvae, number of spawning days ranged from 5 to 19 between years and among sites. Genetically derived estimates of N_s were lower but generally concordant with empirical estimates of available spawners (N_c) based on sex ratios and maturation staging of adults captured independently (N_s/N_c ratio = 0.683). Results increase our understanding of White Sturgeon reproductive ecology and recruitment, and allow projections of cohort levels of genetic diversity. Similar data can be applied to recovery planning and aquaculture programs for this and other species of conservation concern.

5.10 CLBMON-29 Lower Columbia River Juvenile Sturgeon Monitoring

5.10.1 Status

This monitoring program was initiated in 2008 and will be carried out over 12 years. The reports for Years 4 and 5 are in finalization and will be included in next year's submission. They will be included in next year's submission and are delayed due to multiple groups being involved in contributing to the work. Similar to CLBMON-28, one major addition to the program is the initiation of a systematic stock assessment that was started in 2013 to estimate the number of White Sturgeon in the transboundary reach of the Columbia River. This study represents the first systematic population estimate for the entire transboundary reach and one of the objectives is to estimate survival of hatchery released juvenile in this reach. This is the first example of the proportional abundance of hatchery released juveniles in comparison to wild fish and will be used as part of the recovery program to determine how changes to the conservation aquaculture program are implemented.

Additionally, significant progress has been made in understanding juvenile White Sturgeon ecology in the lower Columbia River since this program was implemented. In recent years progress has been made regarding describing habitat use and one

focus has been describing the diet of juveniles in different habitats. Annual growth in the wild for endangered juvenile White Sturgeon in the lower Columbia River is influenced by site fidelity, which is hypothesized to be a function of food availability or composition. We have worked to describe i) food availability and the diet of juvenile White Sturgeon, and ii) the reliability of non-lethal gastric lavage in describing the diet. Fish were angled in October of 2012 and 2013. A non-lethal gastric lavage (GL; n=108) sample was collected, the individual was euthanized, and stomach contents (SC; n=48) were collected. Benthic samples (BS; n=57) were collected from areas of juvenile capture to describe food availability. Prey diversity was influenced by habitat selected, not by fish size, age, or food availability, with fish in deeper slower water having the highest number of prey taxa (mean=4.6). Prey in GL, SC, and BG explained 52, 59, and 70% of the total prey taxa identified (n=27), respectively. GL was 74% efficient in describing total prey taxa (n=19) in the diet and a minimum of 50 samples were required to describe the diet to this level. Results improve knowledge of juvenile sturgeon feeding ecology and suggest that non-lethal GL can be used to assess diets when fish cannot be sacrificed. We have proposed using these consistent methods over the next few years of the program to identify if shifts in the diet occur due to variation in river productivity or as juveniles grow and start to compete with adult food sources (e.g. live fish). This will be important to track, especially as the abundance of juveniles has dramatically increased in a population that was recently absent of juvenile age classes. This, combined with changes to the aquatic community in the lower Columbia River (e.g. invasive species) will be important to monitor.

5.11 CLBMON-30 Lower Columbia River Opportunistic Assessment of High Flow Events

5.11.1 Status

This monitoring program was initiated in 2009 and will be carried out over 10 years. No report is attached as the program requires a long term data set on White Sturgeon movements in order to address the management questions related to flows. In the first few years of this work, all adult White Sturgeon that were required for the study were fitted with acoustic transmitters to monitor movements. A report addressing the data collected and the river conditions experienced to date as they related to the management questions is in preparation and will be included in next year's submission.

5.12 CLBMON-54 Mid Columbia Effects of REV 5 Flow Changes on Incubation and Early Rearing Sturgeon

5.12.1 Status

This monitoring program was initiated in 2010 and will be carried out over a four-year period ending in 2014. This program is implemented concurrently with CLBMON-20 and has a similar update to the one provided above. No report is attached. The expected final report has been delayed due to additional substrate analysis and modelling scenarios developed to incorporate several proposed flow treatments and further address the management questions. The additional work also including expanding the modelling through BC Hydro's Revelstoke Unit 6 environment project, which has proved beneficial to the analysis being conducted under the Columbia

WUP study. The report covers a significant amount of work and should be final in August of 2014 and will be submitted in next year's report.

This project is based primarily on advanced hydraulic modelling which has taken a three-year period to validate with field sampling over a range of Revelstoke Dam Discharges and Arrow Lakes Reservoir elevations. The work has been implemented with CLBMON-20, due to similarities in management questions and methodology. The overall objective of these studies is to model the effects of Revelstoke Dam discharges and ALR levels on velocity/depth patterns in the White Sturgeon egg deposition/incubation and early rearing area. More specifically, CLBMON-54 looked to determine the effects of the addition of Revelstoke Unit 5 on substrate conditions in the spawning area. Using modelling results and what is known about White Sturgeon spawning and early rearing habitats, inferences will be made regarding the potential effects on White Sturgeon spawning suitability. The modelling results have been extremely informative to date and the model was also expanded to help determine any incremental effects of the increased discharge from the addition of Revelstoke Unit 6 on sturgeon spawning habitat. The work is going to be an important piece of literature demonstrating the usefulness of such techniques in describing both hydraulic properties of critical fish habitat and possible mitigation options

6 Summary of Physical Works

6.1 CLBWORKS-24 Mid Columbia Experimental Aquaculture

6.1.1 Status

This physical works was initiated in 2007 and was carried out over five years ending in 2012. It is now complete and CLBWORKS-25 has been initiated to continue conservation aquaculture in the Mid-Columbia.

6.2 CLBWORKS-25 Mid Columbia Sturgeon Conservation Aquaculture

6.2.1 Status

This physical works was initiated in 2012 and will be carried out over five years ending in 2017. Attached is the report for Year 2 dated May 2014.

This program is a continuation of CLBWORKS-24. One primary goal of CLBWORKS-25 is to release juvenile sturgeon of a larger body size compared to historical values in order to help address questions of survival under CLBMON-21.

6.3 CLBWORKS-26 Mid Columbia Sturgeon Upgrade Hatchery

6.3.1 Status

This physical works was initiated in 2008 and ended in 2010 with the construction of temporary rearing facilities that could be located on the banks of the Columbia River (e.g., Revelstoke). Currently, the facilities are under operation at the Kootenay Trout hatchery pending a decision in 2009 to not relocate them to the banks of the Columbia without more certainty in how streamside rearing would fit within recovery goals.

6.4 CLBWORKS-27 Lower Columbia Bentonite Addition Experiment

6.4.1 Status

This physical works is planned for implementation in 2014. Terms of Reference are in draft form and will be finalized in late summer of 2014 following technical discussions and review about the best probable course for this conditional study. The study will be implemented in two phases. The first, will involve a scoping exercise to evaluate substrate restoration at several locations in the Columbia River. This is needed due to sensitivities in implementation of physical works due to limited knowledge regarding what changes are needed to substrates at White Sturgeon spawning grounds used in the lower Columbia. Once these changes can be identified, construction details and any associated post monitoring will be resubmitted in a phase two terms of reference.

6.5 CLBWORKS-28 Lower Columbia River Planning and Assessment of WSG Turbidity

6.5.1 Status

This physical works was initiated in 2011 and was carried out over two years ending in 2013. This study has helped to inform development of Terms of Reference and associated physical works options under CLBWORKS-27 by investigating likely causes of recruitment failure as they relate to physical and environmental conditions in the lower Columbia River. This work has been peer reviewed by several technical experts and also serves as an important study discussing historical recruitment patterns for this population.

6.6 CLBWORKS-34 Lower Columbia Sturgeon Conservation Aquaculture Program

6.6.1 Status

This physical works was initiated in 2008 and will be carried out over 12 years ending in 2019. Attached is the report for Year 6 dated May 2014.

There are two noteworthy updates on this program for 2014. The first is a focus of the program on using wild eggs and larvae as supplemental progeny in the hatchery program. This is based on the results of genetic work conducted under CLBMON-28 which suggested that more wild adults could be represented in supplemental hatchery progeny using this method compared to the traditional broodstock program. Starting in the spring of 2014, a pilot program was initiated to investigate this as a conservation aquaculture option going forward. A small streamside trailer has been established on the banks of the Columbia River near the Waneta spawning grounds. One of the goals is to evaluate the number of wild produced juveniles that can be released at one year of age from this program. We will keep all wild eggs and larvae collected in the Columbia River in 2014 and transfer them to the Kootenay Sturgeon Hatchery for rearing. The program will be further evaluated after results from 2014 are final. Artificial broodstock spawning crosses will still be completed to ensure adequate numbers of juveniles are available for stocking in the spring of 2015.

The second update on this program is one of genetic concern. The ploidy of wild White Sturgeon has previously been determined to be octaploid (8N) in Columbia and Kootenay River populations. Concern was raised when a large number of 12N White Sturgeon were discovered in juvenile family groups which were offspring of

wild adult Kootenay River White Sturgeon spawned at the Kootenay Tribe of Idaho (KTOI) Sturgeon Hatchery. The mechanism of this ploidy shift is unknown but it is thought to occur at the fertilization stage and possibly have negative impacts if these 12N individuals were to reproduce in the wild with 8N individuals. Given that there are potential implications to the aquaculture program, the ploidy of the White Sturgeon families being reared at the hatchery was assessed. Two families were identified as having a proportion of 12n individuals: Family 1 was composed of 3% 12n sturgeon while Family 4 was composed of 6 % 12n individuals. Subsequently, we assessed the ploidy of each individual to be released from Family 4 (n=200) to ensure only 8n White Sturgeon were released into the lower Columbia River. This issue is still preliminary in nature and we are taking precaution until it is further understood. Additionally, there is an assumption that this ploidy shift has likely been occurring since the hatchery program has been operational. To address this assumption, the ploidy of all hatchery juveniles recaptured in the lower Columbia River in 2014 will be assessed to determine the incidence of 12N individuals. We are also evaluating the ploidy of all wild sturgeon as well to determine if 12N individuals occur naturally, and at what rate.

7 Monitoring Programs and Physical Works Costs

The following table summarizes the Columbia River White Sturgeon Management Plan WUP monitoring programs and physical works costs approved by the Comptroller and the Actual Costs to April 30, 2014.

Table 7-1: Columbia River White Sturgeon Management Plan WUP Monitoring Programs and Physical Works Costs

Monitoring Programs	Costs approved by CWR	Life to Date Actuals (LTD)	Estimated to Complete (Forecast)	Total Forecast (LTD and Forecast)	Variance Total to Approved	Explanation	Corrective Action
CLB MP5 White Sturgeon Annual Report	\$15,870	\$5,766	\$10,104	\$15,870	\$0	On Track	No Corrective Action
C05 Mgmt Plan Coordination	\$1,669,534	\$363,312	\$734,509	\$1,097,821	\$571,713	Efficiencies found during project implementation	No Corrective Action
C05M19AKIN:SturgeonInvent	\$591,767	\$548,372	\$0	\$548,372	\$43,395	Project Complete	No Corrective Action
C05M19AKIN:SturgeonInvent-ORDM	\$47,474	\$33,419	\$0	\$33,419	\$14,055		
C05M19AKIN:SturgeonInvent-ORImp	\$544,293	\$514,953	\$0	\$514,953	\$29,340		
C05M20AMIDCOLWhiteSturge	\$378,439	\$220,129	\$1,926	\$222,055	\$156,384	Efficiencies found during project implementation	No Corrective Action
C05M20AMIDCOLWhiteSturge-ONRImp	\$65,316	\$38,562	\$0	\$38,562	\$26,754		
C05M20AMIDCOLWhiteSturge-ORDM	\$37,623	\$24,819	\$0	\$24,819	\$12,804		
C05M20AMIDCOLWhiteSturge-ORImp	\$275,500	\$156,748	\$1,926	\$158,675	\$116,826		
C05M21AMIDCOLJuvenileStu	\$1,761,966	\$1,035,404	\$726,562	\$1,761,966	\$0	On Track	No Corrective Action
C05M21AMIDCOLJuvenileStu-ORDM	\$167,316	\$63,875	\$41,317	\$105,192	\$62,124		
C05M21AMIDCOLJuvenileStu-ORImp	\$1,594,650	\$971,530	\$456,532	\$1,428,062	\$166,588		
C05M23AMIDCOLSturgeonEgg	\$1,504,542	\$877,024	\$409,342	\$1,286,366	\$218,176	On Track	No Corrective Action
C05M23AMIDCOLSturgeonEgg-ORDM	\$155,990	\$64,504	\$48,784	\$113,288	\$42,702		
C05M23AMIDCOLSturgeonEgg-ORImp	\$1,348,552	\$812,520	\$360,558	\$1,173,078	\$175,474		
C05M26AKIN:SturgRecoloniz	\$325,523	\$261,954	\$34,906	\$296,860	\$28,663	On Track	No Corrective Action
C05M26AKIN:SturgRecoloniz-ORDM	\$51,455	\$26,260	\$0	\$26,260	\$25,195		
C05M26AKIN:SturgRecoloniz-ORImp	\$274,068	\$235,694	\$34,906	\$270,600	\$3,468		
C05M27AMIDCOLSturgIncub	\$375,879	\$360,581	\$0	\$360,581	\$15,298	Project Complete	No Corrective Action
C05M27AMIDCOLSturgIncub-ORDM	\$56,570	\$35,893	\$0	\$35,893	\$20,677		
C05M27AMIDCOLSturgIncub-ORImp	\$319,309	\$324,688	\$0	\$324,688	(\$5,379)		
C05M28ALC:AdultSturg	\$3,483,799	\$1,082,921	\$1,789,073	\$2,871,993	\$611,806	Efficiencies found during project implementation	No Corrective Action
C05M28ALC:AdultSturg-ORDM	\$422,141	\$94,312	\$148,492	\$242,803	\$179,338		
C05M28ALC:AdultSturg-ORImp	\$3,061,658	\$988,609	\$1,140,581	\$2,129,190	\$932,468		
C05M29ALC:JuvSturgeon	\$3,120,256	\$1,065,170	\$1,286,282	\$2,351,451	\$768,805	Efficiencies found during project implementation	No Corrective Action
C05M29ALC:JuvSturgeon-ORDM	\$218,003	\$85,715	\$107,413	\$193,128	\$24,875		
C05M29ALC:JuvSturgeon-ORImp	\$2,902,253	\$979,454	\$1,178,869	\$2,158,323	\$743,930		
C05M30ALC:Opportunist	\$526,741	\$142,442	\$329,791	\$472,232	\$54,509	On Track	No Corrective Action
C05M30ALC:Opportunist-ORDM	\$131,917	\$39,957	\$53,329	\$93,285	\$38,632		
C05M30ALC:Opportunist-ORImp	\$394,824	\$102,485	\$76,462	\$178,947	\$215,877		
C05M54AMCREffectofFlow	\$328,107	\$185,019	\$0	\$185,019	\$143,088	Efficiencies found during project implementation	No Corrective Action
C05M54AMCREffectofFlow-ONRDM	\$38,208	\$18,727	\$0	\$18,727	\$19,481		
C05M54AMCREffectofFlow-ONRImp	\$289,899	\$166,292	\$0	\$166,292	\$123,607		
C05W24AMIDCOLExpersturg	\$1,783,845	\$1,783,846	\$0	\$1,783,846	(\$1)	Project Complete	No Corrective Action
C05W24AMIDCOLExpersturg-ORDM	\$50,606	\$23,510	\$0	\$23,510	\$27,096		
C05W24AMIDCOLExpersturg-ORImp	\$1,733,239	\$1,760,335	\$0	\$1,760,335	(\$27,096)		
C05W25AMIDCOLConsrSturg	\$3,159,806	\$742,334	\$2,091,026	\$2,833,360	\$326,446	On Track	No Corrective Action
C05W25AMIDCOLConsrSturg-ORDM	\$83,368	\$11,845	\$28,788	\$40,632	\$42,736		
C05W25AMIDCOLConsrSturg-ORImp	\$3,076,438	\$730,490	\$2,062,238	\$2,792,728	\$283,711		
C05W26AMIDCOLUpgrdSturg	\$585,560	\$532,938	\$0	\$532,938	\$52,622	Project Complete	No Corrective Action
C05W26AMIDCOLUpgrdSturg-ORDM	\$9,018	\$6,743	\$0	\$6,743	\$2,275		
C05W26AMIDCOLUpgrdSturg-ORImp	\$576,542	\$526,194	\$0	\$526,194	\$50,348		
C05W28ALCPlnWsgTur	\$182,520	\$77,139	\$0	\$77,139	\$105,381	Project Complete	No Corrective Action
C05W28ALCPlnWsgTur-ORDM	\$33,304	\$16,053	\$0	\$16,053	\$17,251		
C05W28ALCPlnWsgTur-ORImp	\$149,216	\$61,086	\$0	\$61,087	\$88,130		
C05W34ALCSturgAqua	\$2,773,383	\$1,154,965	\$1,357,354	\$2,512,319	\$261,064	On Track	No Corrective Action
C05W34ALCSturgAqua-ORDM	\$152,467	\$29,990	\$46,964	\$76,955	\$75,512		
C05W34ALCSturgAqua-ORImp	\$2,620,916	\$1,124,974	\$1,310,390	\$2,435,364	\$185,552		

OR - Ordered Remissible
ONR - Ordered Non-Remissible

* Red values in parentheses denote overage.